

# Integrated Multi-satellite Retrievals for Global Precipitation Mission (IMERG) Technical Notes

## Monthly Mean Precipitation Rate

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### **1. Intent of This Document**

**1a)** This document is intended for users who wish to compare satellite-derived observations with climate model outputs in the context of the CMIP5/CMIP6/IPCC historical experiments. It summarizes essential information needed for comparing this dataset to climate model outputs. Users are expected to consult with the much more detailed information in the references and links provided here.

It should immediately be pointed out here that IMERG is a multi-satellite product and covers both the Tropical Rainfall Measuring Mission (TRMM) and the Global Precipitation Mission GPM epochs, and as of 2020 covers the period 2000-current.

This NASA dataset is provided to familiarize model analysis communities with the Precipitation Measuring Missions [1][2]. Since one IMERG Monthly global gridded product file comprises several precipitation estimates (variables) at monthly temporal coverage, a dataset with variables of a single standard name covering a longer period of time will be convenient for the model communities. The data used to make this dataset was obtained from

the dataset **GPM\_IMERG** [2] at the Goddard Distributed Active Archive Center (DAAC). This dataset is created by extracting the variable "precipitation" (Multi-satellite precipitation estimate with gauge calibration, Final) from the original monthly dataset monthly product and then combining it in one yearly file. This "aggregation" is done on-the-fly at download time using the NcML functionality of the Hyrax (OPeNDAP) server. It does not introduce any correction or mathematical transformation to data values. The data can be converted to formats supported by Hyrax while downloading data. Spatial subset based on grid cell indices is also available.

Dataset OPeNDAP form (information) links appearing on the ESGF are in a form:

[https://gpm1.gesdisc.eosdis.nasa.gov/opendap/ncml/ESGF/pr\\_mon\\_GPM\\_3IMERGM-06\\_BE\\_gn\\_2011.ncml.html](https://gpm1.gesdisc.eosdis.nasa.gov/opendap/ncml/ESGF/pr_mon_GPM_3IMERGM-06_BE_gn_2011.ncml.html)

where '2011' is an example year of the monthly grids a user would receive in one data file upon download. Note, it is a webenized form of the data file content. Read below how to download the data using this form.

**1b)** For questions on this dataset, contact GES DISC

[gsfc-help-disc@list.nasa.gov](mailto:gsfc-help-disc@list.nasa.gov)

## 2. Data Field Description

The main data variable is "precipitation". Essential technical details can be found in [3]. Table 1 summarizes the basic characteristics:

**Table 1.**

|                        |  |
|------------------------|--|
| Original Variable Name | "precipitation"  |
| Description            | Multi-satellite precipitation estimate with gauge calibration (Final)                |
| Units                  | mm/hr (equivalent of kg/m <sup>2</sup> /hr)  |
| Spatial Resolution     | 0.1 deg  |
| Temporal resolution    | 1 month  |
| Coverage               | Although the grid is global, valid data currently are only within 60S-60N latitudes. |

Even though associated with the GPM core observatory that was launched in 2014, IMERG is actually a multi-satellite product and covers both the Tropical Rainfall Measuring Mission (TRMM) and the GPM epochs, and as of 2020 covers the period 2000-current. It is basically optimal fusing of data from a constellation of partner Satellite Microwave Radiometers and Infrared sensors from Geostationary satellites, as available for the particular period. Rain gauge correction is applied as the final step in the processing.

### **3. Use OPeNDAP to Obtain Data**

These data are available to registered users only. Unless they already have a NASA Earthdata account, users must register before downloading data. Instructions for registration are provided [here](https://wiki.earthdata.nasa.gov/display/EL/How+To+Register+For+an+EarthData+Login+Profile):

<https://wiki.earthdata.nasa.gov/display/EL/How+To+Register+For+an+EarthData+Login+Profile>

The distribution of these data are supported by the NcML module of the Hyrax (OPeNDAP) server [4]. Upon receiving a download request, the NcML module works together with Hyrax in the background to read and package the monthly files into one yearly file which is then sent out to the end user. This action does not introduce any corrections or mathematical transformations to the original data values.

Instead of the traditional “List of files” or a wget script, we provide a link to an OPeNDAP webenized form to provide more functionalities. This form provides a convenient interactive way for users to remotely browse, subset, and download data of interest.

[https://gpm1.gesdisc.eosdis.nasa.gov/opendap/ncml/ESGF/pr\\_mon\\_GPM\\_3IMERGM-06\\_BE\\_gn\\_2011.ncml.html](https://gpm1.gesdisc.eosdis.nasa.gov/opendap/ncml/ESGF/pr_mon_GPM_3IMERGM-06_BE_gn_2011.ncml.html)

At the top of the OPeNDAP form there are several tabs for “Actions” such as “Get as ASCII”, “Get as NetCDF 3”, “Get as NetCDF 4”, etc. Clicking on any of them will trigger data download

in the corresponding format. Without checking (selecting) any of the “Variables”, all variables will be included in the output.

Selecting a variable will show available index ranges in square brackets, and subset options in the boxes below them:

|  |                                       |                                       |
|--|---------------------------------------|---------------------------------------|
| <input checked="" type="checkbox"/> pr [ time= 0 ..11] [ lon= 0 ..3599] [ lat= 0 ..1799] (Type is Float32) |                                       |                                       |
| <input type="text" value="0:1:11"/>  | <input type="text" value="0:1:3599"/> | <input type="text" value="0:1:1799"/> |

In this example, the time dimension is of size 12 (months), starting index is "0" (January), the stride is set at "1", and the end index is "11" (December). This is where index-subsets can be configured by the User. User selections for variable and indexes will be reflected in the "Data URL" box at the top of the form:

[https://gpm1.gesdisc.eosdis.nasa.gov/opensap/ncml/ESGF/pr\\_mon\\_GPM\\_3IMERGM-06\\_BE\\_gn\\_2011.ncml?pr\[0:1:11\]\[0:1:3599\]\[0:1:1799\]](https://gpm1.gesdisc.eosdis.nasa.gov/opensap/ncml/ESGF/pr_mon_GPM_3IMERGM-06_BE_gn_2011.ncml?pr[0:1:11][0:1:3599][0:1:1799])

As such, this url must be taken as one string, without new line breaks or spaces, and in general must be perceived for a syntax guidance. (Even though some netCDF-compliant tools can understand it)

It is not a "browsable" url, unless the desired output format is inserted as an extension after the "ncml" string, and before the "?" mark. For netCDF-4 format, and simplified for a full-variable request (by removing the indices) the browsable url is:

[https://gpm1.gesdisc.eosdis.nasa.gov/opensap/ncml/ESGF/pr\\_mon\\_GPM\\_3IMERGM-06\\_BE\\_gn\\_2011.ncml.nc4?pr](https://gpm1.gesdisc.eosdis.nasa.gov/opensap/ncml/ESGF/pr_mon_GPM_3IMERGM-06_BE_gn_2011.ncml.nc4?pr)

Now this url can also be used for scripted data downloads by means of **wget** or **curl**. In the case of **wget**, it is important to use the **--content-disposition** option or else the output file name will assume the ncml file name, the "?" mark and everything after it.

**Warning:** An extension "ascii" would actually send a request to the server to package the original variable "precipitation" from all monthly files from 2011 into ASCII format. In a browser, it will attempt to print all data to your browser window. Since it is a big data volume, this request may time out.

#### 4. Data Citation, Provenance, Algorithm, Validation and Uncertainty estimates

These data should be credited with the proper citation, which for the current V06 of the data is:

Huffman, G.J., E.F. Stocker, D.T. Bolvin, E.J. Nelkin, Jackson Tan (2019), GPM IMERG Final Precipitation L3 1 month 0.1 degree x 0.1 degree V06, Greenbelt, MD, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: [Data Access Date], 10.5067/GPM/IMERG/3B-MONTH/06

These data are distributed from the Earth Science Data Information System and the Goddard DAAC under the short name **GPM\_IMERG**. Detailed information on satellites used, algorithm, and error estimates can be found under the "Documentation" tab of the dataset landing page [2]. The most important essence is summarized in the [IMERG Technical Documentation](#).

#### 5. References

- [1] [Precipitation Measurement Missions](#)
- [2] [IMERG Dataset Landing Page at Goddard DAAC](#)
- [3] [IMERG Technical Documentation](#)
- [4] For OPeNDAP documentation, <http://www.opendap.org/support/user-documentation>